New Design of Spin-Torque Nano-Oscillators

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New types of spintronic devices based on MgO magnetic tunnel junctions (MTJs) with a large magneto-resistance ratio and utilizing all-electrical magnetization manipulation by current, such as spin-torque transfer RAM and spin-torque oscillators, have been successfully developed [1]. Spin-torque oscillators built on MTJs with an in-plane magnetization show high frequency capabilities, but still need an external magnetic field and are characterized by a low output power level [2]. Oscillators on MTJs with a perpendicular magnetization and vortex-based oscillators are able to generate oscillations without an external magnetic field, however, their low operating frequencies, usually below 2GHz, limit their functionality and application as tunable oscillators [2]. In [3] we proposed a bias field-free spin-torque oscillator based on an in-plane MgO-MTJ with a free magnetic layer of an elliptical cross-section not perfectly overlapping with a fixed magnetic layer of a smaller cross-section. However, a disadvantage of such a structure is a very narrow range of frequencies and their weak dependence on the current density. In [4] we presented a novel design of spin-torque oscillators composed of two penta-layer in-plane MgO-MTJs with a common free layer shared by both MTJs. This structure operates without a biasing field at high frequencies. Here we investigate in detail a variation of such a structure: a spin-torque nano-oscillator composed of two three-layer in-plane MgO-MTJs with a shared free layer, in particular the optimization in order to obtain maximum output power.

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